smart cities

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Are Smart Innovation Ecosystems Really Seeking to Meet Citizens' Needs? Insights from the Stakeholders' Vision on Smart City Strategy Implementation

Mohammed Agbali [1,*], Claudia Trillo [1], Isa Ali Ibrahim [2], Yusuf Arayici [3] and Terrence Fernando [1]

[1] School of the Built Environment, University of Salford, Manchester M5 4WT, UK; C.Trillo2@salford.ac.uk (C.T.); T.fernando@salford.ac.uk (T.F.)
[2] National Information Technology Development Agency (NITDA), 28 P/H Crescent, FCT–Abuja PMB 564, Nigeria; dg@nitda.gov.ng
[3] Faculty of Engineering, Hasan Kalyoncu University, Gaziantep 27410, Turkey; Yusuf.arayici@hku.edu.tr
* Correspondence: M.Agbali@edu.salford.ac.uk

Received: 27 March 2019; Accepted: 14 June 2019; Published: 24 June 2019

Abstract: The concept of a smart city is becoming the leading paradigm worldwide. Consequently, a creative mix of emerging technologies and open innovation is gradually becoming the defining element of smart city evolution, changing the ways in which city administrators are organizing their services and development globally. Thus, the smart city concept is becoming extremely relevant on the agendas of policy-makers as a development strategy for enhancing the quality of life of the citizen and improving the sustainability goals of their cities. Despite of the relevance of the topic, still few studies investigate how open innovation shapes the way cities become smarter or focus on the experiences of professionals to understand the concept of a smart city and its implementation. This paper fills this gap and analyzes the processes for building effective smart cities by integrating the different perspectives of smart innovations and using the core components of smart cities according to a conceptual framework developed in previous research. In so doing, it provides useful insights for smart city stakeholders in adopting social and technological innovation to improve the global competitiveness of their cities. The empirical dataset allows examining how "smart cities" are being implemented in Manchester (UK), and in Boston, Massachusetts, and San Diego City (United States of America (USA)), including archival data and in-depth interviews with core smart city stakeholders who are involved in smart city projects and programs across the cases. Results from empirical data suggest that the conceptualization of smart cities across the cases is similar with a strong emphasis on social and technological innovation aimed at addressing municipal challenges in the core sub-systems of the cities, which include mobility, environmental sustainability, entrepreneurial development, quality of life, and social cohesion. The results also reveal benefits and challenges relating to smart innovation ecosystems across the cases and the future directions of their diffusion.

Keywords: open innovation; effective smart cities; emerging technologies; social and technological innovation

1. Introduction

Human civilization in the 21st century recognizes the nexus between globalization and urbanization as the key driver of sustainable development. Arup [1] revealed that urban areas are becoming overwhelmed as 50% of the current global population now resides in cities. This estimate, according to United Nations (UN), is expected to rise above 75% by 2050. As revealed in Arup [1], 50% of the human population (living in cities) generates 75% of the carbon emissions, which are now complicating

the challenges of climate change as the demand for resource utilization continues to increase [1]. Interestingly, 80% of the current global gross domestic product (GDP) is also generated in cities [2]. With the steady growth in the trend of urbanization and its complexities, a number of social and technical challenges arose, demanding the attention of city managers in finding creative and innovative ways to manage such challenges [3]. The smart city concept emerged as a development strategy to address the current problems of urbanization with the central goal of making cities more sustainable.

In order to take advantage of new opportunities in smart city innovation, forward-looking city leaders around the world started embarking on one form of smart city initiative or another in an effort to revitalize economic opportunities while, at the same time, strengthening the global competitiveness of their cities [4]. Specifically, cities such as Songdo (South Korea), Masdar City (United Arab Emirates), and Curitiba (Brazil) developed comprehensive plans for smart city projects and programs with some sort of self-acclaimed smart city label [5]. Similarly, well-known cities in Europe and North America (including Manchester, Barcelona, Dublin, Rio, Helsinki, and Boston) are launching smart city initiatives from a small to a large scale across their city region [6,7]. Despite the importance of the smart city concept adoption, very few research studies developed a comprehensive and systematic understanding of smart city actors and processes that make cities smarter and sustainable. Thus, empirical studies that analyze its actual practice (in terms of how the concept is understood among stakeholders in different cities and the processes, as well as its impacts) are rare. This study also responds to research gap as Paskaleva [8] puts it, whereby no explicit and general attention is yet paid to a number of important questions relating to how open innovation (OI) shapes the way cities become smarter. Additionally, contributions of this study are novel by focusing on the experiences of professionals to understand the concept of a smart city and its implementation. Documented evidence on smart city solutions/technologies for integrating the complex systems of cities remains fragmented and, thus, lacks generalization.

With reference to the framework for assessing the impacts of smart cities [8], this paper investigates the impact of open innovation in smart cities in critical sectors with the aim of understanding the differences between smart city concept in theory and in practice through case studies of three world cities (Manchester in Europe, and Boston and San Diego in the United States (US)). The paper builds a comprehensive understanding of the smart city initiative in these three cities through qualitative data collection and in-depth interviews with core smart city stakeholders in both the public and the private sector in line with the core components described in Reference [9]. In so doing, it fills a gap in the knowledge on the actual implementation of smart city strategies and how far do stakeholders believe that they are contributing to meet citizens' needs. The paper seeks to provide answers to the following questions: (1) What are the main drivers of smart city innovation across the cases? (2) What lessons can be drawn from the experiences of smart city actors and processes? To achieve this goal, the paper examines how developments in open innovation assist in the deployment of emerging technologies through citizen/stakeholder engagement in addressing city challenges. Another question answered by this study is how far smart innovation ecosystems are oriented toward responding to the major societal challenges, according to the understanding of the actors involved in the implementation process of smart city strategies. Furthermore, it looks at how the smart city concept enriches the innovation ecosystems and enhances the improvement and sustainability of cities. This study, therefore, provides useful insights for smart city stakeholders in adopting social and technological innovation to improve the global competitiveness of their cities.

2. State of the Art

2.1. Definition

The term "smart cities" is acknowledged in the theory of smart cities [10]. The phrase is not new, and it is used by technology giants since 2005 when referring to technological innovation for integrating the complex systems of urban development infrastructure. As Reference [4] posited, the

smart city concept derives its origin from various perspectives which include the information city, the digital city, the knowledge city, the intelligent city, and the ubiquitous city. In most cases, these different city labels have some common characteristics. Notwithstanding the wide-spread adoption of the smart city concept, some definitional inconsistencies of it still exist as it is an emerging field of research.

According to Mosannenzadeh and Vettorato [11], the smart city concept developed from three core areas, namely government, academia, and industry, with different viewpoints among the three domains as presented in smart city literature. The governmental interest tends to focus on management concerns regarding urban development and sustainability, the academic literature dwells more on knowledge creation and information development, and the industry literature focuses on business, which includes intelligent products and the services relating to artificial intelligence (AI) and other emerging technologies for urban service integration [3]. In summing it up, Reference [12] defined a smart city as innovation for dealing with urban problems relating to urban agglomeration. These different perspectives and the definitional efforts on smart cities were previously discussed extensively [8,11].

2.2. Smart City Practices and Existing Framework Standards

Innovative developments in technologies affect societies and cities, both of which underwent significant changes in recent years. Regardless of the criticism which can be made against it as a concept, the smart city domain emerged as a novel research area where key industries participate to provide innovative solutions and to advise city managers globally on re-thinking the innovative future of their cities. Over 300 cities around the world, in both advanced and less advanced regions, are participating in this innovative development [13].

Worthy of note is the fact that cities in Europe, America, and part of Asia are taking advantage of the smart city concept as a new approach to urban development and as a way of revitalizing economic opportunities through concerted efforts to upgrade existing or emerging cities in order to, firstly, meet the status of a knowledge-based city and, secondly, to strengthen their global competitiveness [12]. For instance, in Amsterdam, smart city initiatives seek to integrate technology at all levels of the city's sub-systems in order to drive local economic development, as well as improve citizen participation/awareness through competitiveness. The Amsterdam smart city project focuses on two major goals, namely economic development and an improved quality of life for citizens [14]. Similarly, the Barcelona smart city initiative focuses on economic development, green infrastructures, and inclusiveness to promote innovation and to achieve sustainable development based on creativity, knowledge, and innovation [15]. The concept cuts across American and Asian cities including New York, San Francisco, Singapore, Hong Kong, Seoul, Songdo, etc. Developments in Smart City deployment, therefore, tend to suggest that the implementations of new technologies and approaches are critical sources of entrepreneurial development, whereby creative and high-tech industries contribute to the attractive image of a city. Hence, stakeholders place entrepreneurship and innovative development at the core of the smart city construct to drive competitiveness or market-driven urban development [16].

Whilst smart city practices and initiatives vary across different city regions, international organizations and standardization bodies such as the International Telecommunications Union (ITU), the International Standards Organization (ISO), and the International Electrotechnical Commission (IEC) are already rolling out standards for smart city deployment in an effort to harmonize and clarify standard practices within the domain [17]. Other regional bodies and international corporations (British Standards Institution (BSI), American National Standards Institute (ANSI), European Standards Organization, IBM, City Protocol, etc.) are also involved in drafting/defining practices and in adding value to the ongoing efforts toward standards and frameworks for smart city deployment globally. The conceptual framework on key performance indicators (KPIs) for measuring the impacts of smart cities in emerging economies [17] discusses smart city standards and frameworks in detail. This framework identified three core components (smart infrastructure, smart institution, and smart people) within which the impact of smartness can be assessed.

2.3. Open Innovation and Smart Cities

According to Reference [18], innovation involves the creation and marketing of the new. In this context, innovation can be viewed as new method, idea, product, and application of better solutions that meet new requirements. Furthermore, innovation can be summarized as 'novelty in action and ideas that work" [12], whereas open innovation, as summarized by Chesbrough [19], involves using knowledge to accelerate innovation. Open innovation can also be viewed as a model that uses a wide range of external sources and actors to assist them in achieving and sustaining innovation [20].

In relation to smart cities, open innovation is becoming a platform for building smarter cities [9]. With the concept of open innovation, stakeholders can draw on the embedded knowledge of the people, their skills, and their expertise to develop innovative solutions that serves the needs of the citizens and the urban environment [9]. In this context, open innovation eliminates the boundaries between government, firms, and the society at large to ease the processes of inward and outward transfer of innovation, thus boosting research and development (R&D) and service delivery through partnerships. The nexus between open innovation and smart cities can be found in the systematic changes that occur in the way and manner that cities grow smarter. Additionally, open innovation is widely acknowledged as providing valuable platforms for high-quality social interactions and ways in which governments and institutions collaborate within societies relevant to the paradigm of smart cities [4,9]. Thus, innovation in terms of technological, managerial, and policy in solving the "wicked problems" of cities is the main focus of this study. As noted by Reference [12], a smart city is about technological, management, and policy innovation in solving the complex problems of the city.

2.4. Major Drivers of Smart City Innovation

At the core of the smart city concept is service integration across city sub-systems for optimization and the ability to offer new service possibilities to citizens [21]. In this regard, Ghanbari and Laya [21] outlined the following five major building blocks that drive the smart city concept:

(i) Economic, social, and privacy implications;
(ii) Developing e-government;
(iii) Intelligent transport systems (ITS);
(iv) Health and well-being;
(v) The digital built environment.

Depending on the priority or the challenges of a city, it is crucial that its government and city administrators focus on the smart city drivers that are relevant to specific local development objectives. For instance, in Boston, mobility and waste management are major challenges; thus, environmental management and smart mobility (transportation) were identified as the driving forces for its smart city program, which is popularly known as GoBoston 2030 [22]. Similarly, Chicago focuses on four core smart city drivers (i.e., transparency, accountability, analytics, and economic development) as strategies for a smarter Chicago. In Barcelona, traffic congestion, pollution, and noise represent the most significant challenges [1]; hence, the city focuses on relevant smart city drivers to address such challenges.

Specifically, the core drivers of smart cities seek to address issues around environmental improvement (e.g., climate change and air quality), economic growth, cost efficiency, health and safety, quality of life, and so forth. This review focuses on key areas of innovative development in critical sectors, as citizen service clusters, in order to identify the ongoing catalysts for the adoption of smart city deployments using the five building blocks suggested by Reference [21] as a guide. Addressing mobility challenges (i.e., transportation), and a high degree of economic competitiveness, environmental sustainability, and health and safety (health-care service delivery) were well discussed as core drivers of smart city innovation in other studies [23,24]. It is anticipated that participants in this empirical study emphasized that the imperative for these core drivers lies in the criticality of the

related sectors. Interestingly, most of the issues in these sectors are also being addressed across cities that adopted the smart city concept.

2.4.1. The Transport Perspective

In recent years, urban scholars foregrounded the critical role that infrastructure plays in advancing contemporary cities by examining how combined urban networks (for example, freeways, information and communication technologies (ICTs), and other new technologies) impacted the urban environment, especially the movement of people, information, goods, and services within and outside cities [25]. Practices in European and American cities suggest notable examples of service integration and systematic efforts to solve problems concerning congestion in cities; this meant taking advantage of mobile-to-mobile (M2M) communications, as well as the deployment of state-of-the-art applications for parking facilities, real-time information on bus locations/arrival times, and last-mile information for timely decisions on driving routes [26].

Transportation is a critical service within cities and one of the key components of service integration and day-to-day living [26]. In the United States of America, transportation was ranked the second largest source of greenhouse emissions with 29% of total emissions [27]. This suggests that a great amount of the CO_2 emissions that affect global warming are caused by transportation activities (which include metros, buses, trains, trams, and motorbikes). Consequently, cities are placing a strong emphasis on sustainability, smartness, and safety [28] and on introducing smart transport initiatives to improve mobility around the urban environment. Through IBM's Smarter Cities Challenge, a number of US cities also commenced programs aimed at addressing mobility problems around cities, although many are still at the experimental stage. Nevertheless, the impacts of these innovations are already visible in many urban centers. In Boston, for instance, the transport sector is the main focus of the GoBoston2030 initiative to reduce CO_2 emissions [22]. With global warming posing a serious threat to livability and the continuous increase in demand for city transportation, there is a need for controlled transport systems to leverage the influence of new technologies; such development could form the core of smarter city initiatives in different regions.

With advances in new technologies, such as RFID, sensors, and the Internet of things (IoT), communication between devices became simplified, which, in effect, makes transport systems "smarter" to optimize; this subsequently drives operations and improves the experiences of the traveler. Therefore, the concept of the smart city needs to be understood in a cross-sector context to allow for spatial functionality. This is because data derived from a city's sub-systems, which are managed by technologies, shift the utility of the space. Indeed, Kyriazis and Varvarigou [26] proposed the need for eco-conscious public transport systems that will leverage the IoT in a sustainable way in order to realize the full potential of these emerging areas.

2.4.2. The Environmental Sustainability Perspective

One of the core objectives of smart city development is to improve the sustainability of the urban environment with the aid of technologies [29]. According to Lombardi and Giordano [30], environmental sustainability and its issues are considered as important drivers of smart cities and general urban development. Caragliu and del Bo [31] (who re-echoed the assertion that environmental sustainability forms a major strategic component of smart cities) emphasized the need for cities to guarantee the safe and renewable use of their natural heritage. Moreover, Reference [29] acknowledged that a number of smart city studies focus mainly on technical and environmental aspects and that this gives impetus to the recommendation by Angelidou [32] that smart cities should put technologies at the services of their inhabitants and not the other way around. Angelidou argued that human-centered approaches to the problems of the urban environment are essential features of a smart city.

The case examples of smart city initiatives in environmental sustainability focus mainly on emergencies, air quality, climate change, and waste management. For instance, the Manchester smart city initiative in air quality monitoring is a typical example of a climate change agenda that aims

to reinvigorate the need to adopt new technologies/techniques for urban sustainability governance while stimulating economic growth [33]. Moreover, Grossi and Pianezzi [34] reported that Genoa is partnering with Toshiba and Selex to deploy smart city solutions to address the challenges of hydrological instability in order to reduce the potential for future emergencies in the area. In the area of waste management, North American cities, such as Boston, Seattle, Pittsburgh, and New York, are integrating the smart city concept into the Open311 non-emergency digital platform for real-time urban maintenance services [35]. In addition, these cities are also pushing the promotion of green initiatives to the next level through "trash-tracking" which is a geographic information system (GIS)-based smart innovation aimed at addressing the challenges of waste management and urban sustainability [36].

2.4.3. The Healthcare Perspective

Healthcare is one of the critical sectors of cities and national economies across the globe. Research on intelligent healthcare systems in smart cities proposed that remote healthcare (smart and efficient) service provisions should represent a major component of a smart city concept in order to improve the quality of life for an increasingly urban population [37]. However, a number of privacy and security-related issues were raised with respect to the deployment of emerging technologies for mobile health (m-Health) and smart health (S-Health) in smart cities [38]. Ding proposed the implementation of some effective information protection methods for m-Health to better ensure privacy and security in an efficient/sustainable manner.

Similar research studies into ubiquitous technologies also offered a cloud-based publish/subscribe framework to manage the complex applications for healthcare and public safety in smart cities. Through a real-world implementation (pilot) in Bristol, research into healthy cities [39] offered a means of deploying ambience assisted living (AAL) to bridge the gap between the state-of-the-art provision and the demand for the healthcare services in smart city regions. Due to the IoT, communities are now connected in new ways, which potentially helps form a happier environment in smarter and connected communities [40]. Harnessing the potential of the IoT, therefore, could benefit healthcare delivery to improve individual well-being and the overall quality of life of the population.

2.4.4. The Economic Perspective

Economic competitiveness remains the central issues in public policy around the globe. Thus, the city economy according to Chourabi and Nam [23] is the major driver of smart city initiatives, and cities with higher degree of economic competitiveness are thought to possess properties of a smarter city. In line with this, a number of smart city scholars (Giffinger and Fertner [41]) identified economy as one of the core components of Smart Cities. In addition, the pursuit of improved economic opportunities and social benefits was noted as the ultimate drivers of smart cities [42]. Thus, the adoption of a smart city as a development strategy clearly suggest the importance of economic development as a key driver.

2.4.5. The E-Governance Perspective

Active involvement of key stakeholders in all sectors and communities is considered essential to a successful smart city initiative [3]. As noted by Reference [43], e-governance is important for enabling a smart city by bringing the people to the smart city initiative and keeping the decision-making and implementation process transparent. Thus, driving a citizen-centric governance through smart city initiatives is at the core of many smart cities.

3. Methods

This section describes the methodology and methods employed for data collection and analysis in this study. Because the study aims at unveiling the actual implementation of smart city policies in three case studies, as it is perceived by the main actors in this process, the epistemological stance is based on constructivism. Each of the three smart city initiatives chosen as case studies corresponds to a sub-unit of analysis and is characterized by varying degrees of innovation and at different levels of maturity.

The three cases were drawn from Europe and North America (Manchester in Europe and Boston and San Diego in North America) and investigated between the second quarter of 2016 and third quarter of 2018. It is anticipated that this study adopts a case-study research strategy (multiple cases) and that the research methodology is qualitative, mainly resting on 23 in-depth interviews conducted within the three sub-units of analysis.

3.1. Research Context and Case Study Selection

The smart city phenomenon is a rapidly evolving field with different cities adopting smart services for addressing city challenges to a different degree and in different contexts [4]. This study, therefore, adopts a multi-case study approach for studying the rapidly evolving nature of the smart city phenomenon across the selected city regions [44]. The selection of the cities as cases for investigation also followed a purposive approach toward an information-oriented strategy [45]. Consequently, the selection of cases for field investigation started from literature evidence that supports what the cities are in theory, backed with official reports about the cities and their websites; all of this was explored within the period of data collection. Thus, this study conducted a systematic literature review on the existing body of knowledge relating to open innovation in smart city practices and on cases in both advanced and less advanced regions in order to identify cities with active participation in smart city innovation (being mindful of their level of maturity in terms of access to credible information and the willingness on the part of top practitioners to participate in this study). The systematic review adopted in this study involved a variety of strategies which include keywords and subject headings relevant to the topic in order to integrate data across studies. The review focused on electronic databases using well-known databases including SCOPUS, IEEE Explorer, Google Scholar, and ACM Digital Library. The search was limited to abstracts in English language but included all smart city research outcomes from both developed and developing countries.

Furthermore, the three cities included in this study as cases of smart city innovation were strongly recommended during the conceptualization processes of this research in the form of focus group interaction with experts in academia and industry who were acquainted with smart city deployment around the world. The participation of the authors in the Multidisciplinary Approach to Plan Smart Specialization Strategies for Local Economic Development (MAPS-LED) research project, a European Union (EU) Horizon 2020 funded program, also influenced the selection of the Boston and San Diego cases. Through the MAPS-LED project, the team generated high-quality data through feedback from knowledge-rich smart city stakeholders across the cases.

3.2. Data Collection

The study was initially based on data gathered from secondary sources (including policy documents and relevant smart city industry reports). To ensure consistency across the analysis of the three cases, the study adopted the framework described in Reference [17]. A list of smart city stakeholders was generated, consistent with the mentioned framework, which included the city mayor's office (information technology (IT) division, smart city units, the resilient unit), top executives of smart city-related organizations in both public and private sectors, as well as participants from academia. In-depth face-to-face interviews were administered with key actors across the cases in order to provide a well-organized understanding of the real-world deployment of smart city solutions, with case examples. Stakeholders were asked specific questions on their major smart city drivers and on the specific city challenges for which the smart city solutions had the potential of addressing in their cities. The interview guide and the set of questions used for the interviews were the same throughout the field investigation across the three cases. Fundamental questions relating to stakeholders' understanding of the smart city concept and the core focus from conceptualization to implementation of smart initiatives including identification of city challenges that they seek to address through their smart city innovation were asked. Other questions were about an overview of the existing smart city initiatives trying to

build a proper understanding of how the introduction of new technologies to cities can help solve problems, as well as documenting their success stories and lessons learned.

A total of 23 in-depth interviews were administered between the second quarter of 2016 and the third quarter of 2018. Due to the accurate sampling, resting both on the literature review and on local experts' advice, and due to the extent of information gathered from the interviews, this number can be considered enough to generate credible results. Interviews were conducted in the form of free dialogue in dedicated sessions that lasted 35–70 min with audio recording and note taking. The first set of in-depth interviews was held in Boston between August 2016 and January 2018, the second set of interviews took place in Manchester between March 2017 and August 2017, and the third set of interviews was carried out in San Diego between October 2018 and December 2018. Table 1 presents a summary of the participants' profiles and the number of interviewees (22 interviews) across the cases.

Table 1. Summary of primary data and profile of participants. NGO—non-governmental organization.

S/N	Case	Number of Interviews			
		Public Sector	Private Sector and Industry	Academia	NGO
1	Boston	3	3	3	1
2	Manchester	2	1	1	1
3	San Diego	4	1	1	1
Total		**9**	**5**	**5**	**3**

As shown in Table 1, participants in this study were drawn mainly from the public sector, especially from city authorities and key public institutions. In the case of Boston, external experts were drawn from Microsoft and a few IT companies through the innovation hubs. Across the cases, smart city scholars from MIT, UCSD, and Boston University offered suggestions on salient issues relating to privacy, unemployment, and the future of smart cities, thus contributing to shaping the scope of the study in order to build a proper understanding of the emerging smart city innovations across the cases. The identities of the interview participants are deliberately excluded in this paper due to privacy concerns. Doing so, the main units of analysis are the smart city initiatives shaping the innovation ecosystem in terms of processes, activities, and events were analyzed to understand the differences and commonalities across cases.

3.3. Data Analysis

In this study, the content analysis approach described in Reference [46] was employed to analyze data relating to the three cities investigated and their smart city initiatives. The core components—smart infrastructure, smart institution, and smart people—identified in the mentioned framework developed by Reference [17] were analyzed. The qualitative information elicited through in-depth interviews and publicly available resources across the cases was analyzed in line with the core construct described in the framework for assessing the impact of smart cities [17]. The study adopted a unit of analysis that is uniform across the cases. It analyzed each smart city initiative identified as a unit of analysis at the individual city level.

Individual case analysis was then carried out by building a proper understanding of the smart city echo system evolving in Boston, Manchester, and San Diego in order to examine the major driving forces of the initiatives, their objectives, the core focus, and their potential impact. In doing so, the study analyzed a total of 34 smart city-related initiatives in Boston, Manchester, and San Diego.

4. Results

This section presents the empirical results from the in-depth interviews and the analysis of the relevant smart city industry reports, framework, and policies. The analysis of the selected cases allowed a careful examination of the real-world implementation, experiments, and realities behind the smart

strategies adopted as innovative responses to the growing challenges of urban development. The results provide insights into each of the domains, into the core components of smart cities, including smart infrastructure, smart institution, and smart people already emphasized in theory [3], and feedback provided by the participants of this empirical study.

The field investigation provided evidence that smart city initiatives are influenced by social and technological innovations aimed at improving the quality of life for people, entrepreneurial growth, and the global competitiveness of the cities. The development patterns identified from the open innovation in smart city-related initiatives are summarized and presented in Table 2 in line with the core domains based on the focus of this study.

Table 2. Domain-specific data on the smart city ecosystems in the three cities.

Domains	Cities		
	Boston	**Manchester**	**San Diego**
Smart Infrastructure	- Internet of things (IoT)-based smart bus stops and smart parking - Autonomous vehicles—self-driving cars (NuTonomy) - Boston Hubway project - Wicked free Wi-Fi - Boston smart street project	- Manchester intelligent streetlights - Triangulum smart city initiative - SynchroniCity - Smart parking - Grow green initiative	- Infrastructure asset management - Re-timing streetlights - Sensors with Internet of things (IoT) technology - City fleet conversion to electric vehicles (EVs) and hybrids
Smart Institution	- Boston's new urban mechanics - Open data initiative - GoBoston 2030 - BOS:311 non-emergency contact centers - Boston innovation districts—"live, work, play"	- Our Manchester strategy framework - Open data Manchester - CityVerve (Manchester's smart city demonstrator) - Connected healthy city initiative (to use city data in improving healthcare)	- San Diego open data portal - MetroLab network - Open counter business portal - San Diego 2030 district - 511:SD non-emergency contact centers
Smart People	- Online gaming - Participatory China town - Boston local sense laboratory (hypothetical testbed for citizen science)	- Support for local innovation ecosystem - The Manchester open innovation challenge	- Bike-sharing initiative - SmartCity Hackathon—app to detect parking

4.1. Smart Infrastructure

The presence of eco-friendly transport innovations and emerging mobility solutions was a common development identified within the smart infrastructure domain based on the outcome of the field investigation. In this regard, 13 initiatives (including the availability of intelligent streetlights, IoT-based bus stops/smart parking solutions, and city fleet conversion to electric vehicles (EVs) and hybrids with great potential for improving air quality and a greener environment) were considered as smart solutions aimed at addressing the global concern regarding climate change and the development of sustainable transport systems in smart cities. These key initiatives were identified and analyzed case-by-case as key findings in the preceding section.

4.2. Smart Institution

In the domain of smart institution, the existence of political commitments through strong policy frameworks (such as the GoBoston 2030, Our Manchester Strategy Framework, and San Diego 2030 District) were identified as committed efforts for creating enabling environments for smart city deployment. In this area, 14 initiatives (including Boston's New Urban Mechanics, CityVerve—Manchester's Smart City Demonstrator, San Diego MetroLab Network, BOS:311 Non-Emergency Contact Centers, Open Data Manchester, and 511:SD Non-Emergency Contact Centers) were also identified as innovative efforts towards improving the institutional component of smart cities. The key findings relating to institutional capability across the cases were also presented in the preceding section.

4.3. Smart People

In the domain of Smart People, seven initiatives (including Boston's Participatory China Town, Manchester's Open Innovation Challenge, San Diego's SmartCity Hackathon, Online Gaming, Boston Local Sense Laboratory, and the Bike-Sharing initiatives) were identified as part of the ongoing innovative developments toward improving the quality of life for citizens.

5. Key Findings and Analysis

5.1. The Case of Boston

The city of Boston is one of the beneficiaries of the IBM's Smarter Cities Challenge grant in North America [6]. Literature evidence suggests that Boston's New Urban Mechanics, set up about ten years ago by Mayor Menino, serves as an essential mechanism for innovation in the smart city investments in Boston [2]. In particular, Boston is involved in a number of initiatives, such as setting up platforms for innovation ecosystems through the innovation hubs/districts, as well as encouraging PPP (public–private partnerships) by collaborating with key industry players. In this regard, the successful launch of "GoBoston 2030" (now called Imagine Boston 2030) is helping the city leadership to transform the city into an innovation laboratory focusing on "people", "places", and "data". In addition, the state government also developed a state-wide innovation strategy for deploying new technologies targeted at the health sector in order to advance the accuracy, efficiency, quality, and availability of healthcare delivery whilst also reducing cost [6].

Interviews revealed that the city of Boston, through the New Urban Mechanics and the Department for Innovation and Technology (DoIT), successfully incorporated technology into the city-wide vision GoBoston 2030. The Boston smart city focuses on what the city refers to as "civic innovators" to improve social entrepreneurial development and to build a healthier environment through open data as a core element of their smart city innovation.

5.1.1. Smart Infrastructure

In terms of smart infrastructure, Boston started laying solid foundations for smart city deployment in core sectors such as transportation. As noted by Buscher and Doody [2], Boston is one of the traffic-prone cities of North America, ranked as the fifth most delayed traffic-prone city with over 300,000 commuting into the city on daily basis. Specifically, Boston deployed IoT-based smart bus stops and smart parking solutions as part of the "complete street" smart city initiative to give drivers real-time parking information. The initiative also seeks to improve air quality by reducing the congestion and air pollution associated with drivers circling around a neighborhood in search of a parking space. Furthermore, the findings of this research study also reflect that, in Boston, innovative technologies for autonomous vehicles is a priority area to improve the environment, safety, access, and sustainability. As revealed by the interviews, Boston started experimenting with the concept of an autonomous vehicle in collaboration with NuTonomy (as a private partner) and the Massachusetts Institute of Technology (see Figure 1). The autonomous vehicle innovation is part of the preparation for fully autonomous fleets to improve the ride-sharing services planned to be in full operation by the year 2021.

Figure 1. Boston's autonomous vehicle (sourced from Reference [6]).

In terms of intelligent sensor-based infrastructure deployment, the findings of this exploratory research reflect that Boston is testing several smart city services relating to modern changes in the enforcement of traffic rules, in public education, better signage, and sidewalks. For instance, interview participants in both the public and private sectors cited a case example, the "Boston Smart Street Project", as one of the successful sensor-based smart city experiments in Boston for improving roadway safety (Table 2). From the perspective of access, experts' interviews revealed that Boston introduced the "Wicked Free Wi-Fi" outdoor wireless network for citizens to connect with other inhabitants and with online shopping. Other initiatives mentioned by the participants included the "Boston Safest Driver App" to monitor and track drivers' behavior on the road remotely in real time, the expansion of the downtown area into a mixed-use neighbourhood, the setting up of a local sense laboratory to serve as a testbed for smart city solutions, etc.

5.1.2. Smart Institution

In smart cities, the governance and management of innovative projects and programs are crucial. In Boston, a consensus exists among the key stakeholders (especially in the area of leveraging the platform of strong innovation hubs to build institutional capacities for deploying smart solutions in the critical sectors of the city). Interviews suggested various institutional insights tailored toward creating an enabling environment for smart city innovation. A number of interviewees talked about policy directions and the commitment of the mayor's office in championing smart city initiatives in close collaboration with key industry players and academia. Across the core sectors of the city, the mayor's support and policy directions shape the overall smart city strategies with various initiatives formed in line with the "civic innovators" vision, encouraging interdepartmental collaboration and public–private partnerships (PPP).

Specifically, the city's leadership set up robust and well-organized innovation platforms (such as the New Urban Mechanics) and a host of innovation districts for interactive and participatory development. In this regard, the New Urban Mechanics serves as an essential civic innovation incubator, as well as a research and development (R&D) laboratory, to create a link between the citizens, government, and social entrepreneurs to innovate around an efficient service delivery in the city. The participants in this empirical study also emphasized open data as the core element of their smart city innovation aimed at opening up city data (such as school and educational data) for value addition. Furthermore, the city also invests in the open data initiative in an effort to provide "last-mile information" for timely decisions on transportation routes and access through the high-connectivity

infrastructure [6]. Similarly, through IBM's Smarter Cities Challenge, prototyping in Boston, open innovation in open data was emphasized by the participants regarding the efforts to unlock, share, and analyze city data for future benefits and improvement while also releasing several applications for the visualization of big data in a consumable manner.

The senior executives interviewed commonly stressed the strategic role of envisioning smart city initiatives to facilitate city-wide commitment to the initiatives. In this regard, GoBoston 2030 seeks to align the city's resources (including people, place, and things (data)) to mobilize researchers, entrepreneurs, and other practitioners in co-creating a smarter Boston with ambitious goals. In terms of improving institutions with regard to efficient and timely service delivery, the city of Boston relies on BOS311—citizens' connect—deployed as a cutting-edge tool enabling residents to take an active part in improving their neighborhood through the timely reporting of issues such as graffiti, potholes, and other service disruptions, and it also encourages the sustainability of strategic developments. The interview participants also cited the Boston Innovation District's "live, work, play" as an innovative response from the city during the economic downturn to gain faster innovation to spur sustainable economic growth.

5.1.3. Smart People

With regard to smart people, the city of Boston prides itself on being the intellectual hub of America, a status seemingly associated with the higher concentration of R&D institutions within the metropolis. Smart city initiatives in Boston promote citizen and community engagement, through which the city solicits ideas and feedback from the people. "Developing smart" in this sense means to better understand the citizens' needs and opinions on smart initiatives embarked upon by the city leadership at various levels. In this regard, the premier universities and other R&D institutions located in the city of Boston are proactively involved in rolling out innovative R&D results, helping accelerate smart and sustainable city deployment around Boston.

Evidence from this empirical study shows that the smart city model in Boston offers improved services through the provision of up-to-date information in a proactive way to encourage citizens' participation in the decision-making processes aimed at making their daily experiences in the city more meaningful and comfortable. In this regard, Boston embarked on a massive awareness program to educate citizens on climate change action as part of the smart city initiative using "online gaming". Online gaming serves as a platform for communication, education, and social change approaches to raise climate change awareness among citizens. Enhancing citizen participation in governance is crucial to the success of the smart city initiative; to this end, Boston's participatory neighborhood planning process through the "Participatory China Town" represents a participatory process of data collection for planning and policy development. In addition, Boston also set up the "local sense lab" to serve as testbed for smart city solutions and capacity building. The local sense laboratory focuses on hyperlocal data on how people live and on sensor data to transform the cities, change lives, and change businesses in Boston.

5.2. The Case of Manchester

Literature evidence suggests that the European Union (EU) provides financial support to facilitate the implementation of innovative development in the energy and technology sector relating to smart cities and communities [47]. To this end, the EU supports smart city-related programs in several European cities (including Manchester) in ongoing regional efforts toward smart and sustainable cities. Manchester seeks to leverage the nexus between smart cities and emerging open data innovation in shaping the growth of the city through the traditional sustainability-related initiatives for global competitiveness [5].

According to top executives interviewed in Manchester, the move toward a smarter Manchester commenced three decades ago with some initiatives, such as the "knowledge society framework"

developed in 1990. The interviewed participants in this study acknowledged that the strategies around smartness tend to work better when they are linked to wider urban strategies.

5.2.1. Smart Infrastructure

In Manchester, smart city deployment commenced in earnest by leveraging the IoT to build a smarter and more connected Manchester city. The interviewees in this empirical study revealed that Manchester started the deployment of IoT solutions for "talkative bus stops", smart lighting, smart air quality monitoring, and community wellness programs. The IoT initiative, coordinated by CityVerve, is sponsored by Innovate United Kingdom (UK). The Manchester CityVerve is a PPP arrangement involving stakeholder organizations in both public/private sectors and academia. It includes the Manchester City Council, the University of Manchester, British Telcom (BT), Cisco, and a host of others.

In terms of promoting a healthier environment, Manchester embarked on the "Grow Green" initiative to promote high-quality green spaces in communities around the city (Figure 2). The city also launched a similar initiative to encourage the positive use of data and technologies through the CityMoves project for healthy living. The CityMoves initiative was experimented between 23 October 2017 and 21 December 2017 and it was adjudged to be a successful trial according to the smart city stakeholders in academia and the health sector. Although the air quality monitoring initiative was an ongoing initiative at the time of the field investigation in Manchester, the interview participants did, however, describe the initiative as one of the strategic smart infrastructure deployments in Manchester, helping in making decisions with direct impacts on wider cleanliness and on the sustainability of the city especially in the areas of health, transportation, and traffic management.

Figure 2. Air quality sensor network, Manchester Oxford Road (sourced from Reference [48]).

From the perspective of an intelligent and sensor-based infrastructure for mobility services, the outcome of this empirical study revealed some strategic innovations in this area including the sensing tram, smart traffic monitoring, and smart parking. the sensing tram initiative was launched to provide real-time tram information to passengers to improve the travel experiences of the citizens. The smart traffic monitoring leverages IoT technologies in monitoring vehicular traffic patterns in the city and is aimed at reducing pollution and making the city more sustainable. The smart parking initiative focuses on providing citizens with parking space tracking and availability in real time, based on driving routes.

5.2.2. Smart Institution

In reviewing the governance mechanisms or institutional arrangements for smart city deployment in Manchester, the interviewees reflected on key issues relating to the "Our Manchester" strategy,

open data for collaboration, SmartImpact, and regional participation through SynchronCity initiative. In smart and sustainable cities, a policy framework that supports institutional and governance mechanisms is crucial. In this context, the city of Manchester put in place a people-oriented policy strategy with a time line (2015 to 2025) and measurable targets emphasizing job creation/healthy business environment, world-class talent, equity, a great place to live, world-class transport systems, and a brilliant broadband infrastructure, to promote smart innovation for the city.

In the area of open data, the outcome of this study reflects that Manchester was the first in the history of the UK to open up city data in 2010. Open innovation relating to city data is helping the city region to improve data-sharing among the municipal authorities, improving collaboration between the city and innovators especially in identifying needs and the right solutions, with the active participation of its citizens.

In terms of SmartImpact, some of the initiatives under the CityVerve smart cities demonstrator were designed to enable the Manchester city region to be the first in the UK to achieve a decentralized control over critical sectors such as health, transport, social care, and housing. The other similar initiative mentioned by interviewees is the Connected Health City initiative launched as an integral part of health innovation to support the spread of open data in the health sector, for improved impact on the health and wellbeing of citizens. A major step toward building institutional capability for smart innovation was the official launch of the Manchester Inspired Innovation Digital Enterprise Alliance (Mi-IDEA) in September 2017. As noted by one of the key stakeholders, Manchester's model of a start-up ecosystem is totally different from what can be found in any other city. Manchester has a different approach altogether, making the concept act as the focal point for co-innovation that will serve as a platform for bringing together the top policy-makers, key industry managers, and their counterparts in academia to build a blueprint for the city's dream smart city. It is the hub for the smart city demonstrator in Manchester.

5.2.3. Smart People

Citizens' engagement in identifying problems that should be solved via smart city solutions is crucial. In this context, Manchester focuses on supporting a successful local innovation ecosystem, in order to strengthen local investors, to enable the city to respond to current global changes in the business start-up environment. As recounted by one of the interviewees, through the implementation of integrated strategies for social inclusion, Manchester is making assertive moves to address existing socio-economic disparities and any other form of inequality in the city that can hinder the achievement of a decent quality of life. Manchester's strategies of addressing inequalities through the smart city concept is similar to Barcelona's model of inclusive entrepreneurship strategies that encouraged the establishment of over 18,000 start-up companies/businesses and which generated over 32,000 new jobs for the city [49].

In addition, Manchester launched the "open innovation challenge" aimed at helping the transformation of the city through the introduction of smart technologies. The open innovation challenge, according to interviewees, is in collaboration with Cisco and Manchester Science Partnership (MSP).

5.3. The Case of San Diego

The *Smart Cities* journal described the city of San Diego as one of the forerunners of smart city innovation, setting the pace for other cities to follow [47–51]. According to Reference [47], ICT and technology-based transformation is the major factor in San Diego's claim to be a "city of the future".

The outcome of this exploratory study revealed that the San Diego smart city initiative started from the 511 free phone and web service consolidation of the regional transportation information to provide a general one-stop service resource on transportation. The 511 initiative, as explained by a top executive, is similar to New York City's 311 non-emergency initiative for responsive and efficient service delivery. The San Diego smart city initiative encourages the innovative deployment of new technologies to help the city to operate much more efficiently in terms of cost and quality of service.

5.3.1. Smart Infrastructure

The deployment of smart city solutions commenced fully in San Diego through the innovative adoption of new technologies that people increasingly use for efficient service delivery and information sharing. The participants in this study revealed that the city of San Diego commenced the deployment of smart city solutions in critical sectors, in line with the regional "climate action plan". The initial prototyping and testing of smart city deployments focused mainly on urban transportation for mobility options. San Diego, as a city region with the world's largest military settlement (with over 100,000 defense personnel) also seeks to leverage smart city innovations in key defense industries which manufacture military drones, navy ships, and secured military communication hardware that will be relevant in smart cities.

The deployment of emerging technologies for environmental and mobility services is a common priority among cities adopting a smart city as a development strategy, In this area, San Diego set a new record for the world's largest deployment of IoTs in the urban environment with 2200 intelligent streetlight nodes deployed with cameras and microphones capable of detecting crimes, gunshots, environmental disasters, or climate information (e.g., temperature) in real time. As revealed by the interviewees, San Diego is partnering with General Electric (GE) to install an additional 4200 sensor nodes through CityIQ as part its IoT project which will assist in a real-time emergency response system for the city. The initiative will support a new app for improving the smart parking system and also one for improving efficient traffic management. With the new IoT and sensor-based solutions, the city is ready to leapfrog the smart city technologies in delivering location information in real time, a cost-effective energy management system, and emission reduction to achieve its goal of combating climate change.

From the perspective of promoting a cleaner environment and deploying a smart infrastructure for mobility services, this study revealed some innovative strides being taken in San Diego which include the city fleet conversion to electric vehicles and the "proven ground for autonomous vehicle" experiment. The city fleet conversion seeks to improve air quality through clean transportation in order to reduce greenhouse gas emission and air pollution in the city (Figure 3). In San Diego, the concept of autonomous vehicles as part of a city-wide smart city innovation is a priority in order to reduce greenhouse gas emissions, as well as deploying them for border security. As explained by a top executive, "improving the quality of life for the people through the innovation and deployment of new technologies for efficient services is very important to us in San Diego". Examples include having a drone or autonomous vehicle in an emergency situation to take a blood sample to testing for a quick diagnosis instead of driving the patient on the road to the hospital; this can reduce the time of care and also the risk of losing the patient before reaching the hospital facilities. According to interviewees, the use of autonomous vehicles is a typical example of life-saving technology within smart cities that San Diego is already discussing with key hospitals to implement. Additionally, San Diego was declared as a "proven ground" for autonomous vehicles, which makes the city a national leader in demonstrating how technologies can be used to provide better services in the city. The testing is concentrated around the city of Chula Vista within the San Diego metropolitan area.

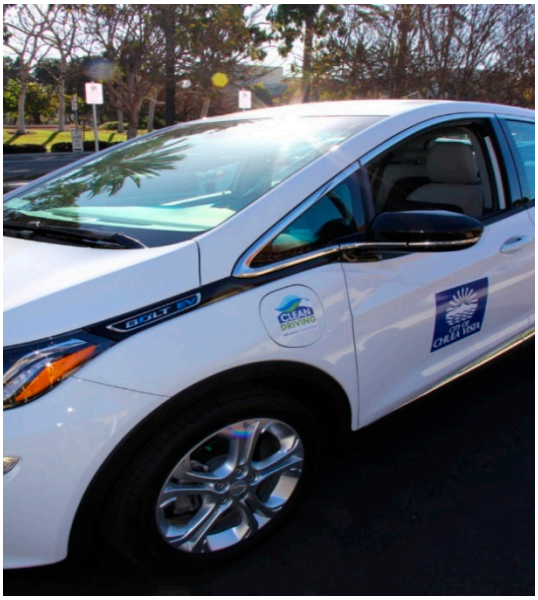

Figure 3. Sample of a Chula Vista clean driving vehicle (sourced from Reference [52]).

5.3.2. Smart Institution

San Diego claims that the entire region is making Smart City innovation an integral part of every development effort. Senior government officials specifically mentioned the need to take advantage of Smart City innovation in building healthy environments and communities, innovative mobility, and planning, as well as a vibrant economy for San Diego city region. When prompted to cite specific examples of smart innovation addressing the institutional dimension of their Smart City initiatives, interview participants mentioned the San Diego Open Data Portal, the MetroLab Network, the Open Counter Business Portal, and San Diego 2030 District as key initiatives in this domain.

San Diego's open innovation in smart cities, according to the interview participants, interlinks critical subsystems of the city to create a more open and transparent city governance. The MetroLab Network focuses on innovation in city government, data, and analytics. The San Diego Open Data initiative also addresses issues around data access for city operations, especially with regard to public safety, code enforcement, and business licensing. In addition, the city proactively grows its revenue and accelerates job creation through the OpenCounter initiative making things easier for entrepreneurs.

Lastly, the "San Diego 2030 District" is a public–private partnership (PPP) project for urban sustainability. The San Diego 2030 District initiative is managed by CleanTech as part of a smart city collaboration. The partnership is in collaboration with the City Office, University of California San Diego (UCSD), DNV.GL, Measurbl, and local business leaders. The San Diego 2030 District's goal is to reduce energy and water consumption and their associated emissions, as well as lessening transportation emission by 50% by the year 2030.

5.3.3. Smart People

With regard to building capacity in terms of "smart people", San Diego focuses on a bike-sharing initiative and app development for the better management of different city sub-systems through open innovation and open data initiatives. Smart city deployment in San Diego, according to the interview participants, encourages the active participation of people through community engagement in decision-making processes. For instance, to promote a bike-friendly environment within San Diego region as a major step toward achieving the core objectives of the bike-sharing initiative—the iCommute program—the San Diego mayor, the SANDAG board members, the San Diego police, and the Bike coalition periodically embark on awareness campaigns to seek citizens' opinions on the project.

The Bike-Sharing initiative is part of the Climate Action Plan aimed at addressing the "first mile" and "last mile" problem for citizens, especially people who live far away from transit hubs.

The outcome of this study also revealed that the city of San Diego is currently adding apps packages (of around 4200) to its CityIQ intelligent nodes to provide data visualization to assist "first responders" in an emergency, and to improve traffic safety and an efficient parking management system, as well as helping the police in security operations. The apps development initiative also relies on open data and open innovation to proactively address the city's challenges in key areas such as energy efficiency, tourism development, and mobility services.

6. Discussion

The methodologies adopted for this study produced useful insights into the smart cities phenomenon across the cases investigated (see Table 2 and the preceding analysis). Interviewees agreed on the fact that smart city strategies are being deployed through citizen-oriented specific initiatives, capable of adding value to traditional public services through innovative solutions. This study notes that the creative use of city data to promote innovation through the open data initiative was a common feature in smart city evolution across the cities investigated.

An important finding concerns the importance of a policy framework and strategies for smart city deployment. The three cases investigated followed well-articulated policy documents (which may differ in terms of strategies and priority areas, but which bring forth similar outcomes). The outcomes from Boston, for instance, show that Boston articulated policy documents (Imagine Boston 2030 and transport-focused GoBoston 2030) well organized as groundwork to drive zero emissions, zero deaths, zero stress, zero injuries, and a zero-disparity vision of the city. In addition, the Boston smart city initiative is in line with the US Department of Transportation overall policy. In Manchester, the Manchester City Council recently adopted a new digital strategy for smart growth to show the ways in which the city intends to deploy emerging technologies that will help in meeting the city's objectives [48]. The new digital strategy, according to the interview participants, outlines how the application of new technologies can promote civic innovation in order to make Manchester more "livable". The strategy also emphasizes the need for digital education and skills, digital infrastructure, digital public services, and digital future-proofing for the city. As revealed by senior city managers, the Manchester smart city efforts follow the smart city planning guidelines document (PD 8101) and other framework standards developed by the British Standards Institution (BSI). Similarly, an outcome of this research study shows that San Diego is leveraging the Climate Action Plan (CAP) and the San Diego 2030 District project for complete transformation into a smart city environment. Similar to Boston, the San Diego smart city initiative benefits from the US Department of Transportation policy.

Results from the cases show that smart city deployment is largely supported by huge investment in smart infrastructure and technologies which are useful for all cities (regardless of their geographical region) in all their efforts to deal with developmental challenges. In this regard, all case studies demonstrated an adequate capacity and investment in critical infrastructure that is necessary to support innovation in smart city deployment in core sectors (such as energy, transportation, health, and environment). Furthermore, the smart city has the potential to deliver environmental sustainability, to enhance mobility systems, and to improve the quality of life for citizens. These and similar priority areas, including the nature of the innovative ecosystems evolving across the cases, provide answers to research question (1). Specifically, the outcome of this research study from Boston, Manchester, and San Diego shows that smart innovation across the cases is focused on smart transportation options such as city fleet conversion to experimental initiatives in autonomous vehicles (AV), as well as environmental and safety related issues. When asked to state the major drivers of their smart city innovation, interviewees mentioned drivers considered important to their smart city vision with real-world examples of their initiatives as enumerated in Table 2. Across cases, participants consistently referred to driving sustainable economic development, global competitiveness of their cities, job creation, and air quality as major drivers of their smart innovation. Some participants also seized the

opportunity to highlight the existing challenges in key areas including development infrastructure for managing city resources citing instances of energy, use of data, waste management/sanitation, cyber security, cost saving, etc.

Another interesting finding concerns how smart cities can be more sensitive to their environment in terms of crime and security-related issues, natural disasters, and sustainable traffic management systems. All the cities investigated (though mainly the San Diego case) showed a massive deployment of sensor-based solutions and IoT technologies for improving the local quality of life for the people. These results, when compared with the findings by Reference [4] (who claimed that smart city innovation is driven by an intelligent infrastructure that connects new "smart services" and a city's developing infrastructure) allows for the potential of smart interventions in critical sub-sectors within cities leveraging smart city innovation for sustainable development. Although smart infrastructure can be seen as one of the core components of smart cities as noted in previous study [6], the investment requirements to bring it about within a city can be very challenging and may result in delays in the real-world implementation of smart city practices. Thus, city leaders and their technical partners should explore new opportunities with regard to platforms for smart telephones and other hand-held devices as integrated infrastructure platforms for harnessing the benefits of smart city innovation.

Smart cities must address sustainable development through stakeholder involvement and ownership. Smart cities, therefore, require smart institutions to foster stakeholder engagement in terms of interactions between government and business, business and citizen, and vice versa. The outcome of this research study reveals diverse models for smart city governance formations and models across the cases. For instance, the city of Boston set up an innovative smart city platform (New Urban Mechanics) as a testbed for promoting and testing solutions that encourage active citizen participation and collaboration in sustainable smart city deployment. In Manchester, interagency collaboration led to the introduction of a platform for the smart city demonstrator (CityVerve), focusing on core sectors with expertise in different sub-sectors that deliver place-based innovation to address the specific challenges of the city. The CityVerve idea seeks to use Internet of things (IoT) technologies to redefine the concept of smartness in the context of a living, working city [53]. In San Diego, a smart city collaboration was launched as a partnership between CleanTech San Diego (a non-profit organization), SANDAG, and other technical partners (such as GE, Cisco, academia, and a number of local business leaders) to transform the entire San Diego region into a leading smart city region in the world. The lessons learned from the different partnership formations regarding smartness and the strategies of focusing on specific challenges of cities provide answers to research question (2).

The study also noted the commonality of open data innovation across cases (see Table 2). In this regard, the interviewees cited specific initiatives in creating an open innovation ecosystem for enhancing high-quality research and development in smart city deployment. However, interviewees from the non-governmental organizations (NGOs) in Boston complained of the over-concentration of skilled citizens in smart city deployment with little or no contributions from unskilled citizens, and this may be a clear departure from the bottom-up approach via which cities promote the smart city evolution.

Interviewees in this research study believed that smart cities must facilitate the openness of public services and a participatory urban environment for living and working activities. The people-centric smart city initiatives highlighted in Table 2 enhance citizen participation in decision-making processes and governance systems. These smart city initiatives, according to interviewees, were very popular among the people because of an awareness as to how such initiatives can impact on their quality of life. For instance, the China Town initiative discussed in Section 5.1 represents an innovative neighborhood planning and policy mechanism for promoting social cohesion.

7. Conclusions and Future Research Direction

This study presented the findings from an analysis conducted through field investigation and interviews with smart city stakeholders in Europe and North American cities regarding their open

innovation in an attempt to understand the practice of smart city deployment. The paper focused on building a proper understanding of open innovation in smart city practices in the three cities investigated in order to draw lessons according to a consistent conceptual framework.

The three cities investigated present similar experiences and challenges in their smart city initiatives, especially regarding the focus and the core objectives of their innovation. The findings of this study can be viewed as a novel contribution to the ongoing research in the field of smart cities as to how social and technological innovations offer new opportunities in participatory urban planning and sustainable development through citizen engagement in smart city initiatives. The study noted that the major drivers in smart city innovation are similar in different cities in terms of addressing the development challenges of the cities, as well as improving their global competitiveness. In this regard, evidence across the cases and feedbacks from stakeholders shows that attempting improvements in transportation—first-mile and last-mile information, mobility as a service, fleet conversion to electric/connected vehicles, autonomous vehicles, etc.—and environmental issues (air quality) are the common goals of many smart cities. An improved quality of life for people, job creation, and entrepreneurial development were also emphasized through open data for open innovation in smart cities.

In the future, the research focus will address a limitation of this study which is the scope of the field investigation. All the cities covered in this study were drawn from the advanced regions of the world. While empirical evidence from these three cities can be considered sufficient to gain an understanding of smart city practices, many cities in less advanced regions, especially in Asia, that claim to be smart may hold potential sources that will provide alternative experiences for smart city practitioners. Thus, future work will add more smart city cases from less advanced regions in the world to present a more balanced view.

Author Contributions: This paper is based on M.A.'s PhD. He prepared the draft and data collection under the MAPS-LED project; C.T. was the PhD supervisor and the MAPS-LED project UK coordinator, revised the draft. T.F. advised on the methodology; Y.A. supervised the initial stages of the PhD; I.A.I. supported the case study development and the verification of the conceptual framework.

Funding: MAPS-LED research project (Grant No. 645651).

Acknowledgments: We acknowledge Marie Curie (EU's Horizon 2020 program for research and innovation) and the MAPS-LED research project (grant 645651), for supporting fieldwork in Boston and San Diego. However, the research results and conclusions expressed in this work are those of the authors and do not necessarily reflect the views of any organization mentioned in this paper.

Conflicts of Interest: The authors declare no conflict of interest.

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